

# Claims

1. Composition intended to strengthen apatite-based materials, characterized in that it comprises at least one derivative of titanium and of fluorine corresponding to the general formula (I) below:

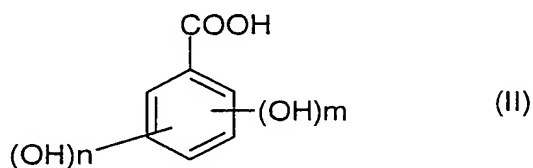


in which

x is an integer varying from 1 to 6 and y is 0, 1 or 2, with the condition that, when y is 0, x does not represent 4,

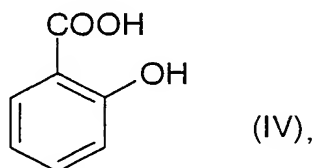
and R represents:

- a component chosen from K, Na or  $\text{NH}_4$ , or
- a ligand L of formula (II) below:

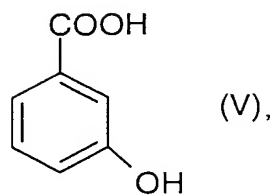


in which m is 0 or 1 and n is 0, 1 or 2; in the form of the base or of an addition salt with an acid, and in the form of a hydrate or solvate, the composition being additionally characterized in that it has, in the dissolved state, preferably dissolved in an aqueous medium, a pH of less than or equal to 6.

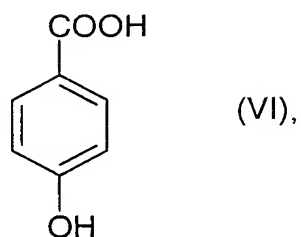
2. Composition according to Claim 1, characterized in that the ligands L are in particular benzoic acid derivatives, in particular 2-hydroxybenzoic acid of formula (IV) below and its derivatives:



3-hydroxybenzoic acid of formula (V) below and its derivatives:

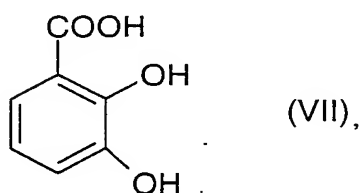


4-hydroxybenzoic acid of formula (VI) below and its derivatives:



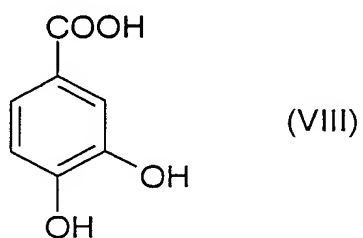
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2,3-dihydroxybenzoic acid of formula (VII) below and its derivatives:

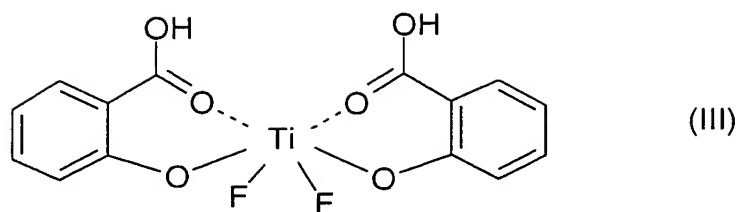


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3,4-dihydroxybenzoic acid of formula (VIII) below and its derivatives:



- 15 3. Composition according to Claim 1, characterized in that the compound derived from titanium and from fluorine is the compound represented by the following formula (III):



4. Composition according to Claim 1, characterized in that the derivative of titanium and of fluorine is in particular potassium hexafluorotitanate of formula  $K_2TiF_6$ , sodium hexafluorotitanate of formula  $Na_2TiF_6$  or ammonium hexafluorotitanate of formula  $(NH_4)_2TiF_6$ .
5. Composition according to any one of Claims 1 to 4, characterized in that it has a titanium content varying from approximately 10 to approximately 1000 ppm, preferably approximately 300 ppm, and a content of fluorine ions varying from approximately 50 to approximately 1500 ppm, preferably approximately 240 ppm.
6. Composition according to any one of Claims 1 to 5, characterized in that it comprises, for topical administration, a compound derived from titanium and from fluorine in an amount such that the titanium content is greater than 0.001% by weight, preferably between 0.01 and 0.1% by weight, more preferably between 0.01% and 0.05% by weight, with respect to the total weight of the said composition.
7. Composition according to any one of Claims 1 to 6, characterized in that it furthermore comprises an additional fluorinated compound, in particular a fluorine salt, for example sodium fluoride or sodium monofluorophosphate, in an amount varying from approximately 50 ppm to approximately 1500 ppm, preferably from approximately 100 ppm to approximately 500 ppm.
8. Composition according to any one of Claims 1 to 7, characterized in that it is administered by the topical route in the form of a dentifrice, of a powder to be diluted, of a spray, of a chewing gum, of a pastille to be sucked, of a gel, of a buccal implant, such as a patch, of a mouthwash or of a solution.
9. Use of at least one compound derived from titanium and from fluorine corresponding to the general formula (I) below:

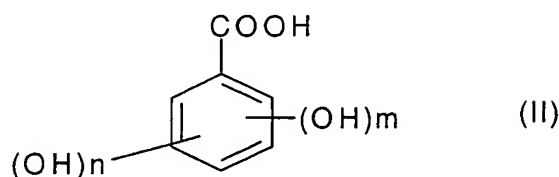


in which

x is an integer varying from 1 to 6 and y is 0, 1 or 2, with the condition that, when y is 0, x does not represent 4

and R represents:

- 5        - a compound chosen from K, Na or NH<sub>4</sub>, or
- a ligand L of formula (II) below:



- 10       in which m is 0 or 1 and n is 0, 1 or 2, in the form of a base or of an addition salt with an acid, and in the form of a hydrate or solvate, for strengthening apatite-based materials.

- 10.       Use according to Claim 9, characterized in that the composition is as defined
- 15       in any one of Claims 2 to 8.

- 11.       Use according to Claim 9 or 10 for strengthening natural hydroxyapatites, in particular dental enamel, dentine or bones, and artificial ceramics based on calcium phosphate intended for medical applications, in particular dental implants,
- 20       percutaneous or periodontal implant devices, or bone prostheses used in orthopaedic, maxillofacial or spinal surgery.

- 12.       Process for strengthening apatite-based materials, comprising the stage consisting in applying, to the apatite-based material, a composition comprising a
- 25       derivative of titanium and of fluorine as defined in any one of Claims 1 to 8, the said composition having, in the dissolved state, a pH of less than or equal to 6.

- 13.       Process according to Claim 12, characterized in that, prior to the application of the composition, a stage of treatment with an acidic or demineralizing compound
- 30       is carried out.

- 14.       Process according to Claim 13, characterized in that the acidic or

demineralizing compound is in particular citric acid, lactic acid, phosphoric acid or tartaric acid.

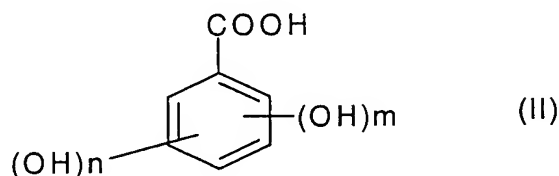
15. Use of at least one derivative of titanium and of fluorine corresponding to the general formula (I) below:



in which

x is an integer varying from 1 to 6 and y is 0, 1 or 2, and R represents:

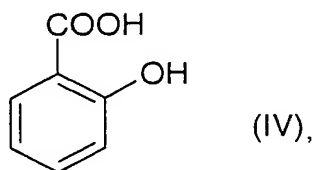
- a compound chosen from K, Na or  $\text{NH}_4$ , or
- a ligand L of formula (II) below:



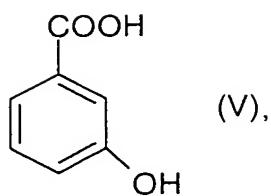
- 15 in which m is 0 or 1 and n is 0, 1 or 2; in the form of a base or of an addition salt with an acid, and in the form of a hydrate or solvate, as agent for combating coloration of apatite-based materials in a composition for buccal use.

16. Use according to Claim 15, characterized in that the composition has, in the dissolved state, preferably dissolved in an aqueous medium, a pH of less than or equal to 6.

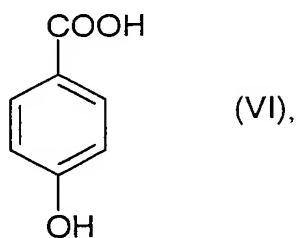
17. Use according to Claim 15 or 16, characterized in that the ligands L are in particular benzoic acid derivatives, in particular 2-hydroxybenzoic acid of formula (IV) below and its derivatives:



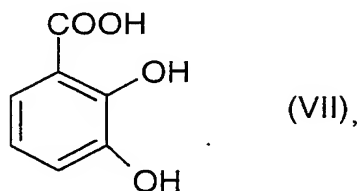
3-hydroxybenzoic acid of formula (V) below and its derivatives:



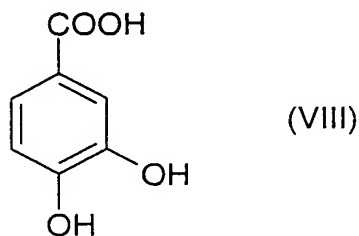
4-hydroxybenzoic acid of formula (VI) below and its derivatives:



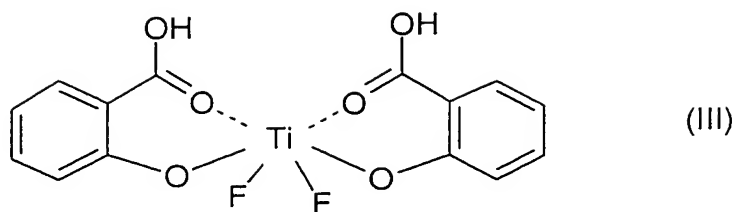
2,3-dihydroxybenzoic acid of formula (VII) below and its derivatives:



3,4-dihydroxybenzoic acid of formula (VIII) below and its derivatives:



- 15 18. Use according to Claim 15 or 16, characterized in that the compound derived from titanium and from fluorine is the compound represented by the following formula (III):



19. Use according to Claim 15, characterized in that the derivative of titanium and of fluorine is in particular titanium tetrafluoride of formula  $\text{TiF}_4$ , potassium hexafluorotitanate of formula  $\text{K}_2\text{TiF}_6$ , sodium hexafluorotitanate of formula  $\text{Na}_2\text{TiF}_6$  or ammonium hexafluorotitanate of formula  $(\text{NH}_4)_2\text{TiF}_6$ .

20. Use according to any one of Claims 15 to 19, characterized in that the composition has a titanium content varying from approximately 10 to approximately 1000 ppm, preferably approximately 300 ppm, and a content of fluorine ions varying from approximately 50 to approximately 1500 ppm, preferably approximately 240 ppm.

21. Use according to any one of Claims 15 to 19, characterized in that the composition comprises, for topical administration, a compound derived from titanium and from fluorine in an amount such that the titanium content is greater than 0.001% by weight, preferably between 0.01 and 0.1% by weight, with respect to the total weight of the said composition.

22. Use according to any one of Claims 15 to 21, characterized in that it furthermore comprises an additional fluorinated compound, in particular a fluorine salt, for example sodium fluoride or sodium monofluorophosphate, in an amount varying from approximately 50 ppm to approximately 1500 ppm, preferably from approximately 100 ppm to approximately 500 ppm.

23. Use according to any one of Claims 15 to 22, characterized in that the composition is administered by the topical route in the form of a dentifrice, of a powder to be diluted, of a spray, of a chewing gum, of a pastille to be sucked, of a gel, of a buccal implant, such as a patch, of a mouthwash or of a solution.

24. Process for protecting apatite-based materials from coloration, comprising the stage consisting in applying, to the apatite-based material, a composition

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comprising a titanium and fluorine derivative such as defined according to any one of claims 15 to 23, said composition possessing, in the solubilized state, a pH less than or equal to 6.

25. The process according to claim 24, further characterized in that, prior to the application of the composition, a treatment step with an acidic or demineralizing compound is carried out.

26. The process according to claim 25, further characterized in that the acidic or demineralizing compound is, in particular, citric acid, lactic acid, phosphoric acid, tartaric acid.